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Bertocci

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(54) **ERGONOMIC SYRINGE AND ADAPTOR**

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A61M 5/315 (2006.01)

(52) **U.S. Cl.**
CPC ***A61M 5/31515*** (2013.01); ***A61M 5/315*** (2013.01); ***A61M 5/31513*** (2013.01)

(58) **Field of Classification Search**
CPC A61M 5/315; A61M 5/31513; A61M 5/31515
USPC 604/181, 187, 207, 212, 214, 218, 222, 604/227, 228
See application file for complete search history.

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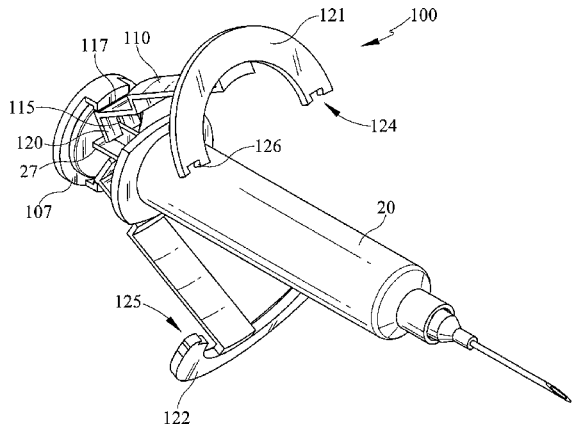
(57) **ABSTRACT**

An ergonomic syringe includes a slide member, wherein force exerted on the slide member causes movement of a syringe plunger within a hollow or partially hollow syringe barrel, for withdrawing fluid from a source into the syringe, and also includes a reusable adaptor for use with existing conventional syringes, which has a ring that wholly or partially encircles the barrel and indirectly attaches to a plunger flange.

8 Claims, 10 Drawing Sheets



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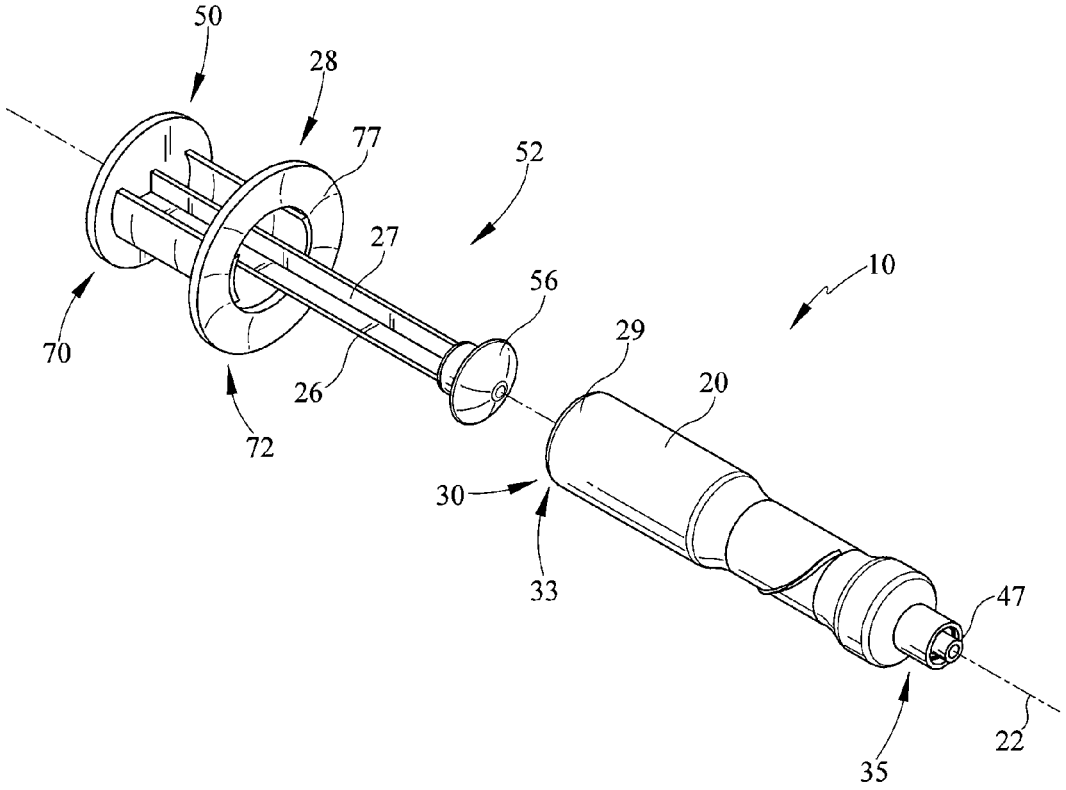


FIG. 1

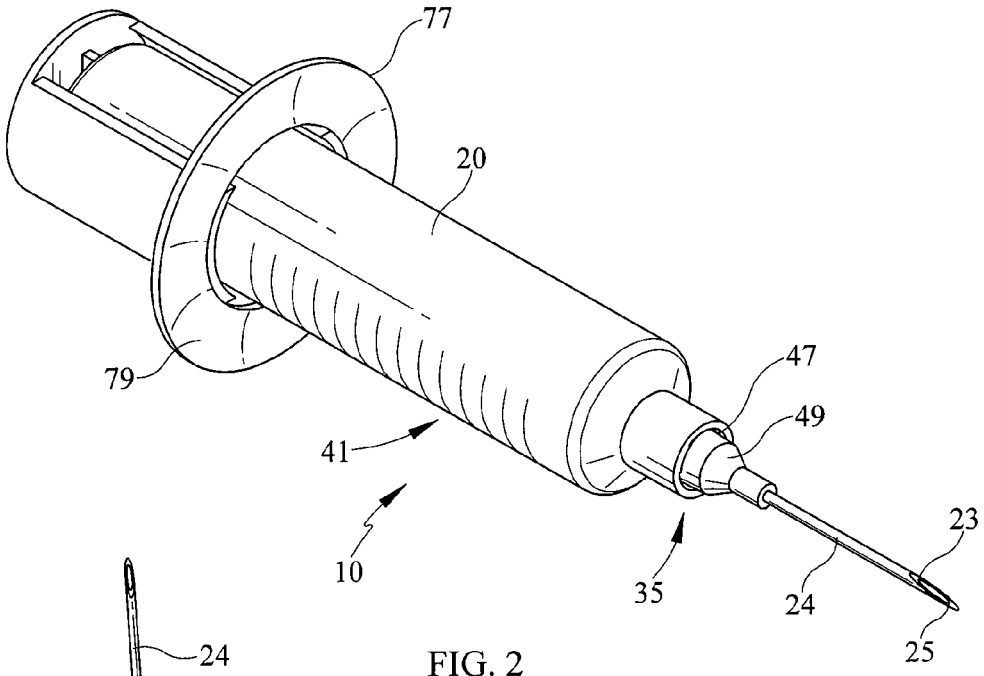


FIG. 2

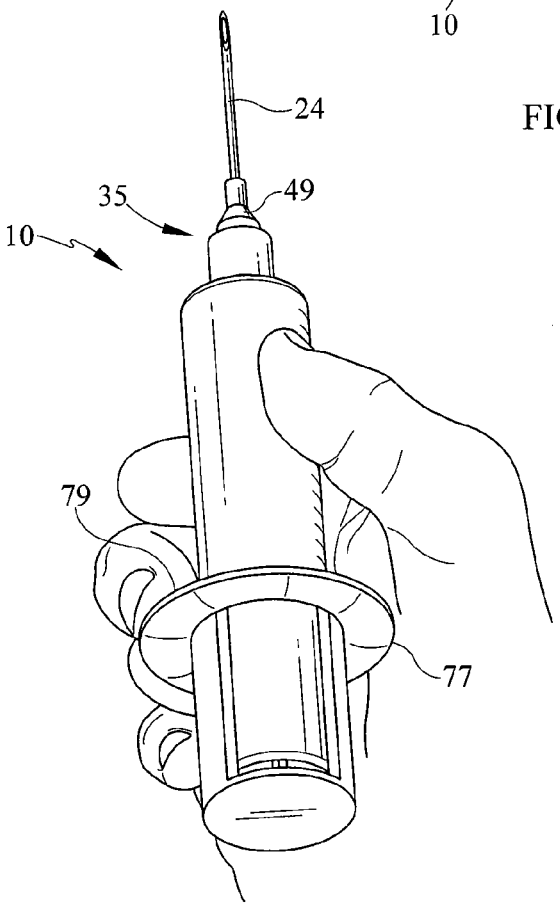


FIG. 2A

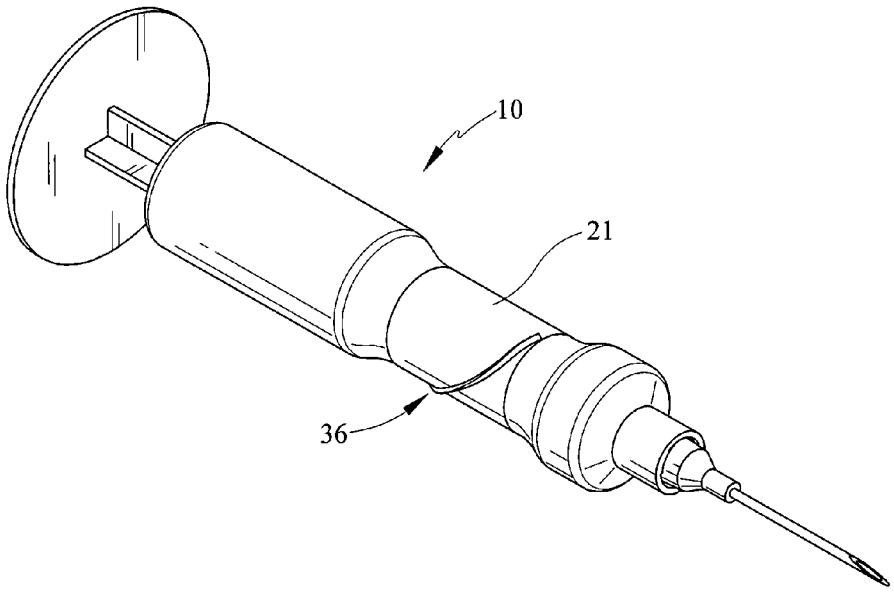


FIG. 3

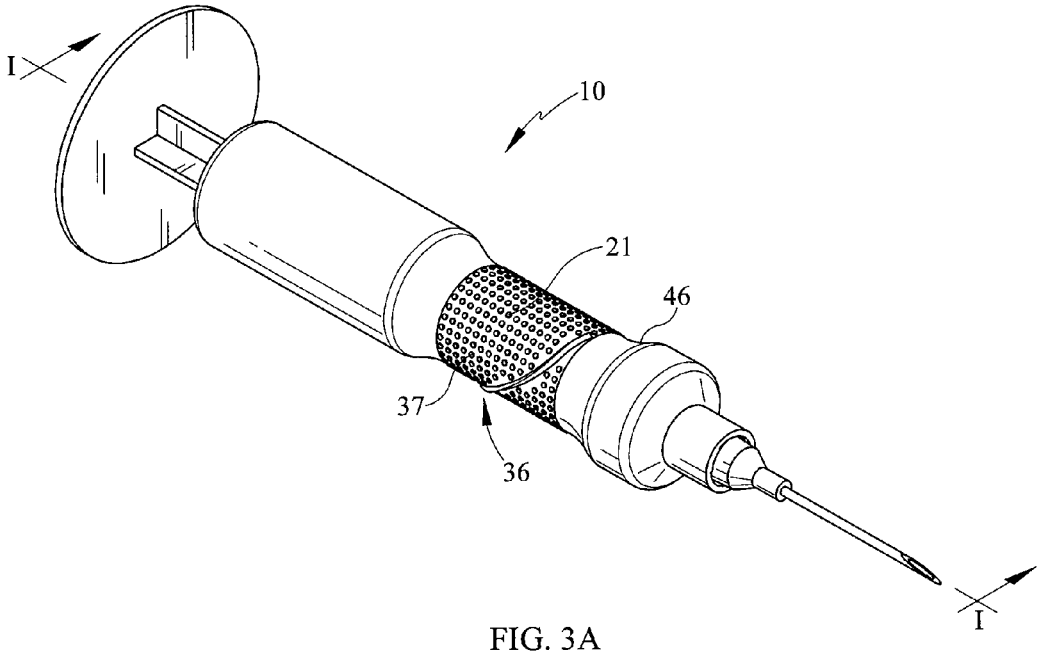


FIG. 3A

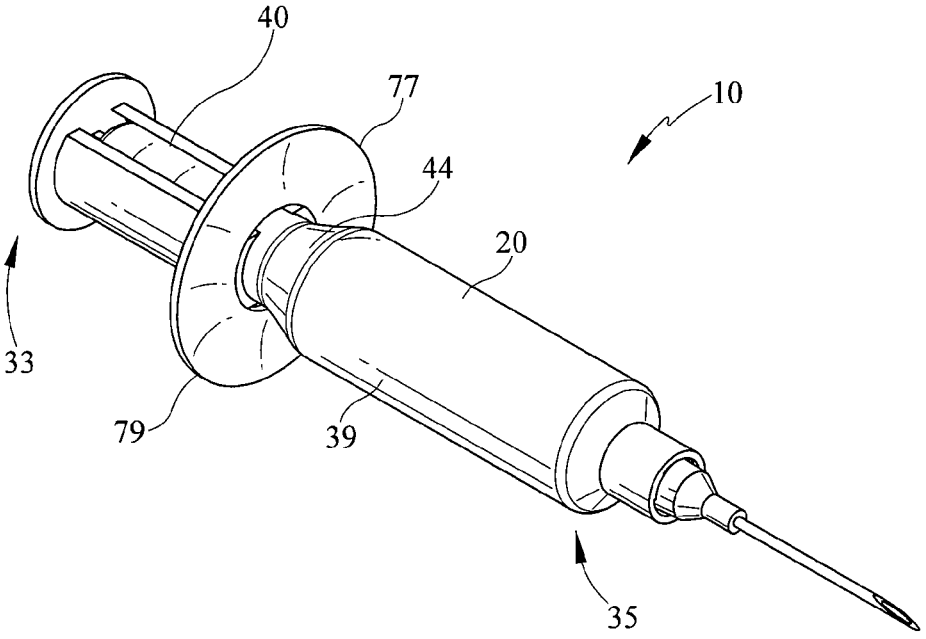


FIG. 4

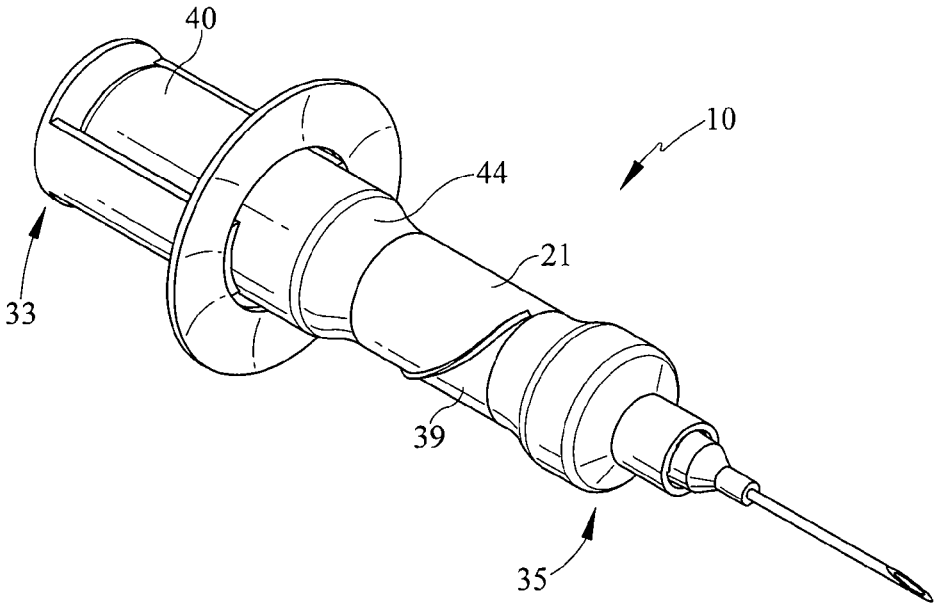


FIG. 4A

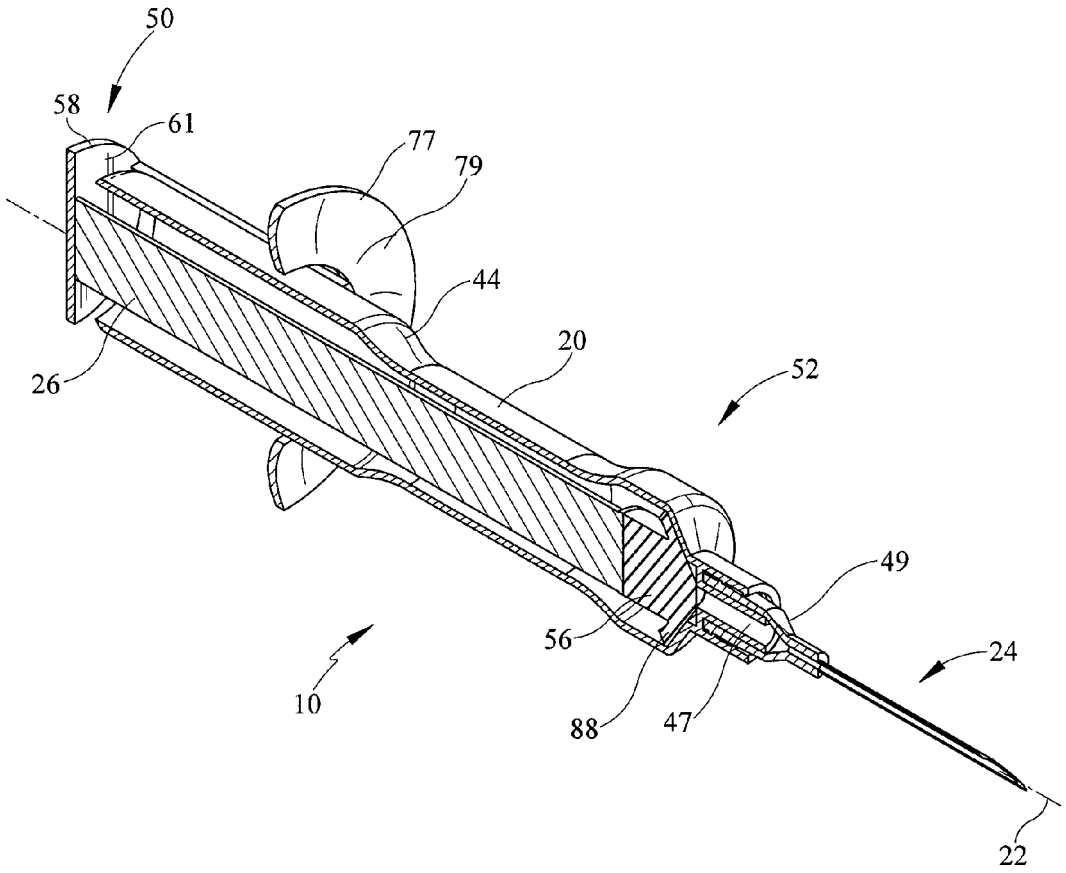


FIG. 5

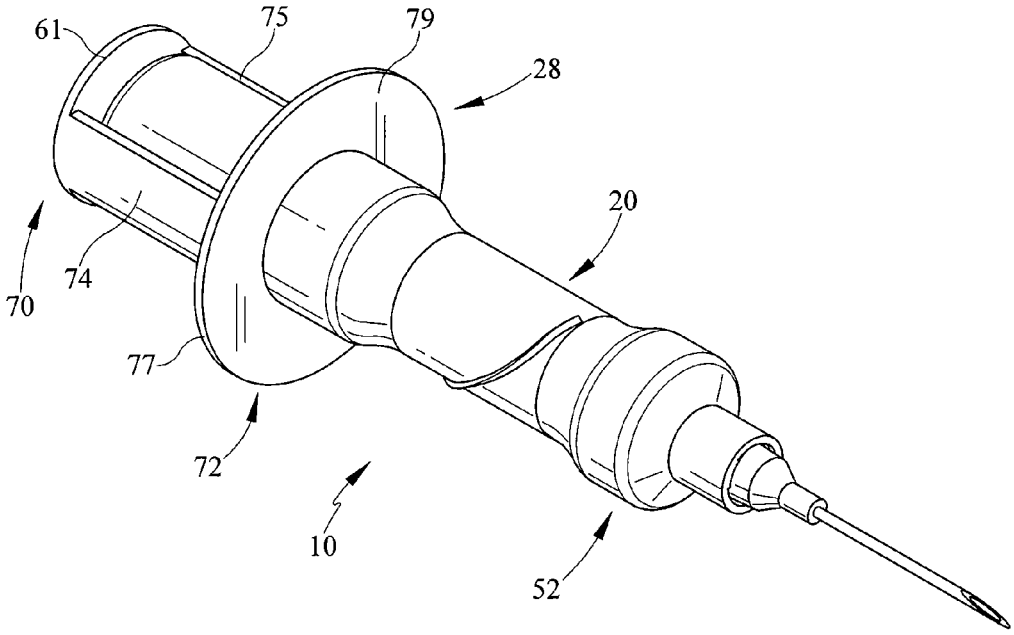


FIG. 6

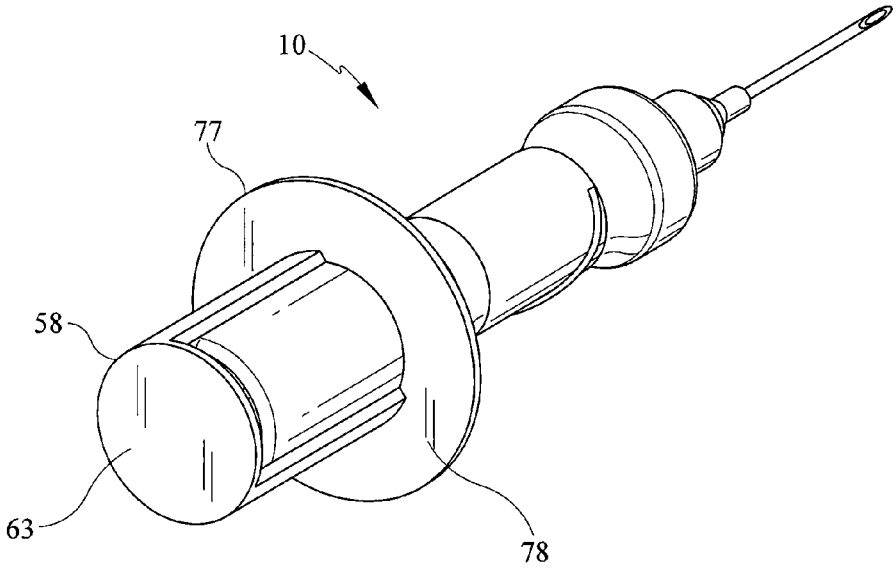
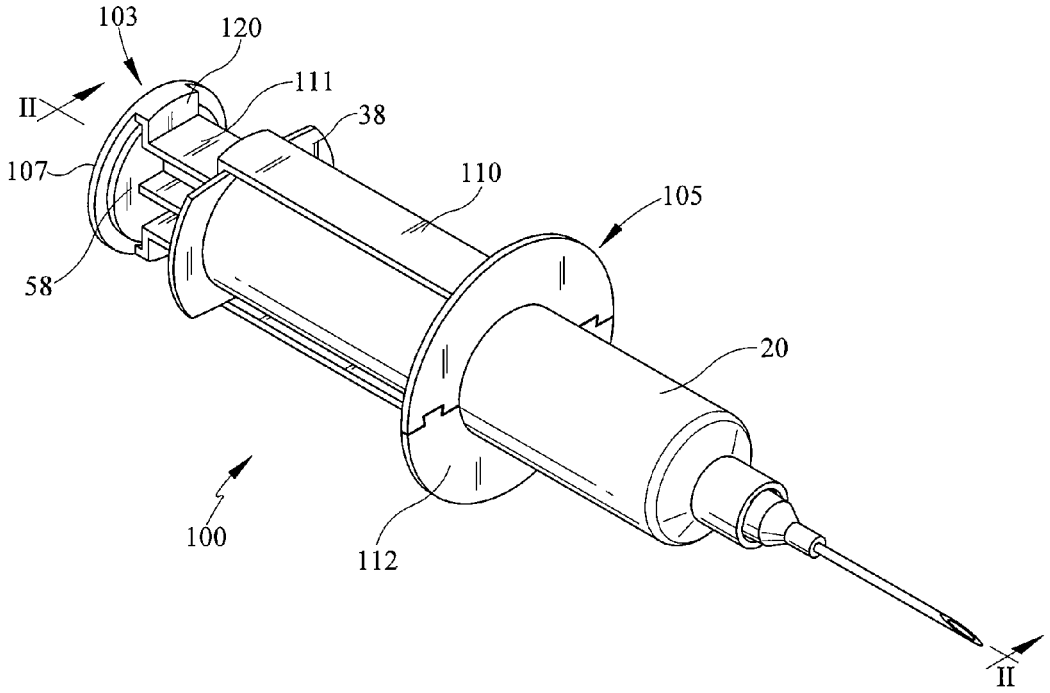


FIG. 6A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II
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105
58
20
100
112
II

FIG. 7

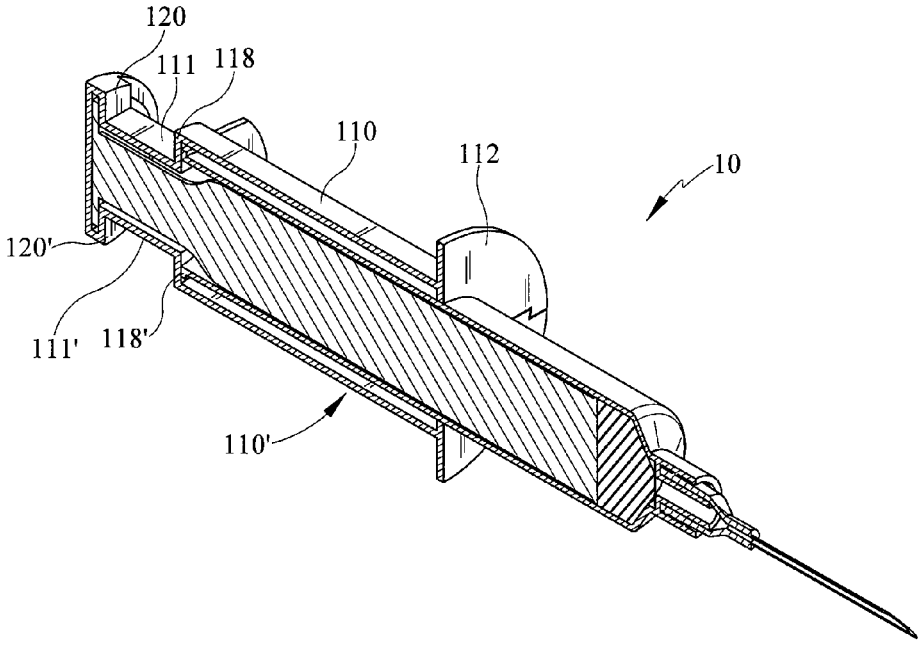
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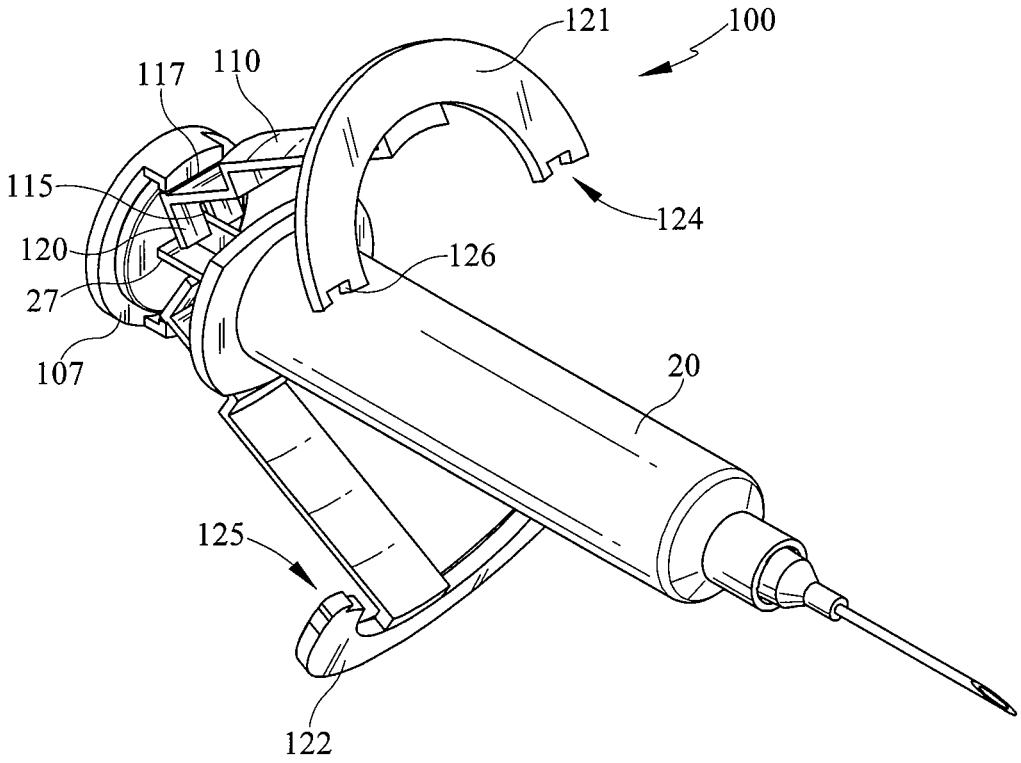
FIG. 7A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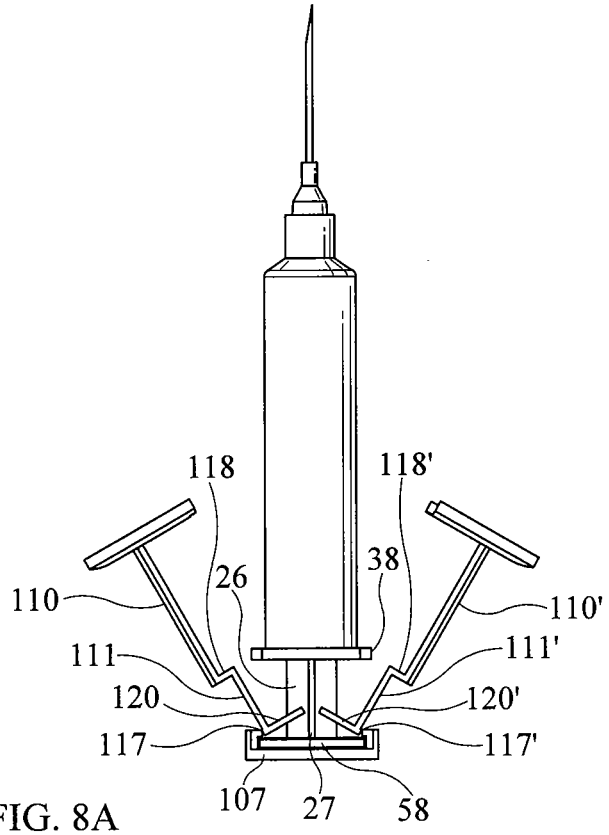
122

FIG. 8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107
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58

FIG. 8A

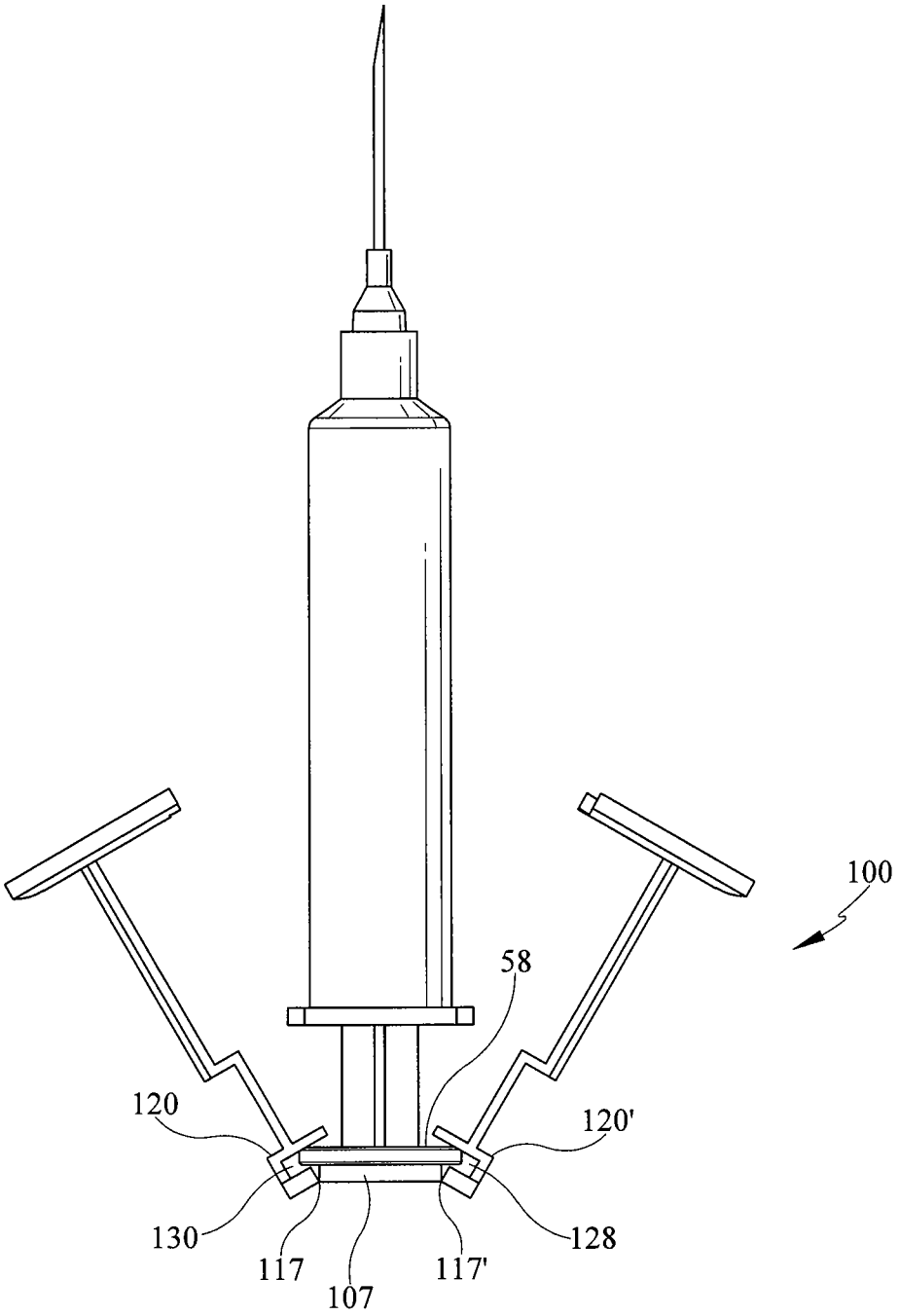

FIG. 9

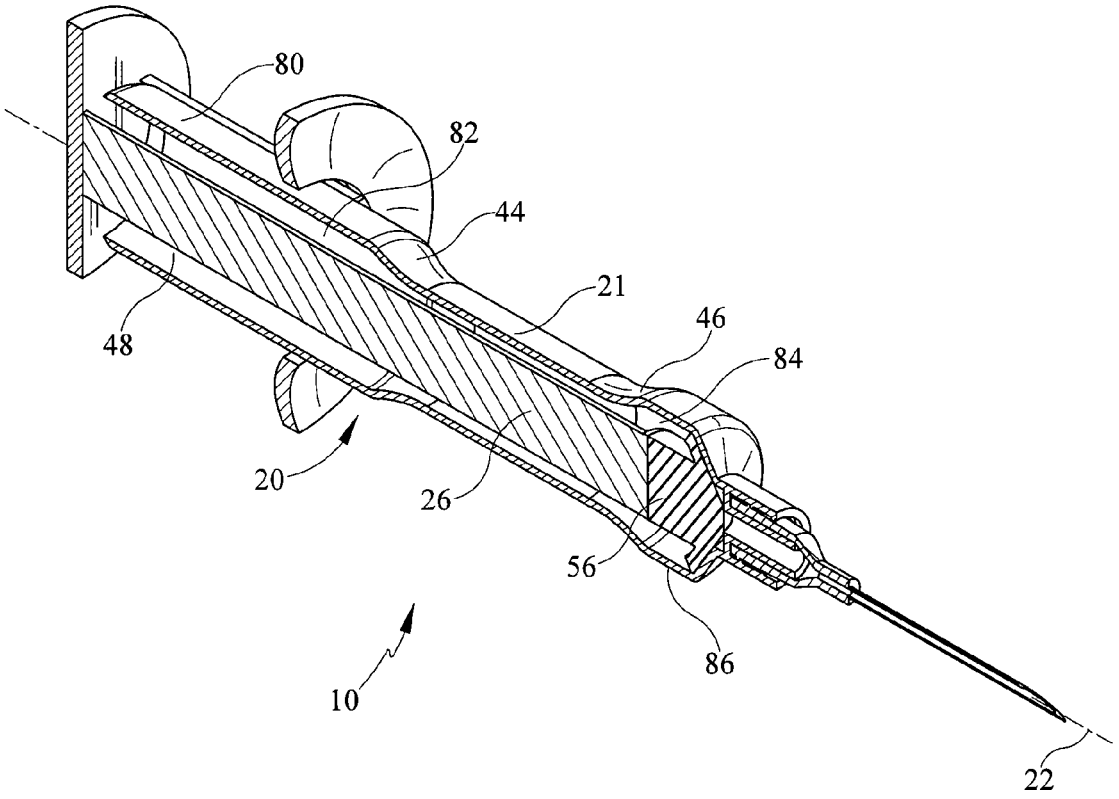

FIG. 10

ERGONOMIC SYRINGE AND ADAPTOR

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application No. 61/562,167, filed Nov. 21, 2011.

FIELD OF INVENTION

The presently disclosed technology relates, generally, to syringe products. More particularly, it relates to syringe products that facilitate ergonomic operation, e.g., single-handed operation of a syringe, and other advantages such as enhanced control and stability.

BACKGROUND

Throughout the descriptions herein, reference is made both to a proximal end and a distal end of various parts of a syringe. Proximal is the end closer to a user's (i.e., an operator's) body when operating a syringe. Distal is closer to the end from which fluid either exits the syringe during injection or enters the syringe during withdrawal.

A syringe typically contains several parts. One is a cylindrical barrel that is substantially hollow. Another is a plunger that partially fits within the hollow space of the barrel. Syringes are used to inject and/or withdraw fluids in various sectors such as, for example, laboratory, human medicine and veterinary medicine fields. The injection and/or withdrawal of fluids can be into/from a blood vessel, tissue, or other body region of a patient.

The plunger either pushes fluid out of the barrel during injection, or pulls fluid into the barrel during withdrawal. Many syringes have a hollow needle or cannula permanently or detachably connected at the distal end of the barrel. Injecting fluid from a syringe is accomplished by pushing the plunger further into the barrel, where the fluid is located. This action reduces the volume and forces fluid to be expelled through an opening of the barrel. Withdrawing fluid from an external source into a syringe is accomplished by partially drawing the plunger from the barrel to create a vacuum, which causes fluid to flow from the external source into the barrel. Typically, syringes have markings on the barrel that signify a quantity of fluid contained therein.

Some syringe plungers have a flange at the proximal end, herein referred to as a plunger flange. In conventional use, one holds or otherwise contacts a surface of the plunger flange to exert a proximal force and withdraw the plunger from the barrel during fluid withdrawal, or to exert a distal force and push the plunger further into the barrel during fluid injection. Some syringes have a flexible, elastomeric member, referred to herein as a sealing member, which fits over the distal-most end of the plunger and facilitates the creation of the vacuum as a user withdraws the plunger. For example, phlebotomy is the withdrawal of blood from a blood vessel, typically a vein. Fine needle aspiration (FNA) means the withdrawal of material from body tissue so that cells can be studied under a microscope. Arthrocentesis involves aspirating a joint to either collect a fluid sample for diagnostic purposes, or to drain effusions from the joint space. Phlebotomy, FNA, and arthrocentesis are situations in which an ergonomic syringe and adaptor would facilitate the withdrawal of fluids from a patient.

Various techniques and finger/hand positions are commonly used for moving the plunger in the proximal direction in order to create the vacuum that withdraws fluid from an external source into the barrel. In conventional operation, a user often must employ a two-handed technique, particularly for withdrawing fluid, in which the user grasps the outer surface of the barrel with fingers of a first hand, while grasping the plunger flange at the proximal end with fingers of a second hand. The user then holds the barrel in a relatively stationary position with the first hand while pulling or otherwise exerting force on the plunger flange in a proximal direction with the second hand to further withdraw the plunger from the barrel. However, a two-handed technique has several disadvantages. One is that, by grasping the plunger flange with one hand and the barrel with the other, the user does not have a free hand available to stabilize the patient's body region or part from which fluid is being withdrawn, which is important in many respects, including in veterinary medicine.

Therefore, instead of using both hands to operate the syringe, in some respects it is more desirable to use only one hand. A one-handed technique provides the user a free hand for performing additional tasks, such as holding onto and thereby stabilizing the patient's limb, tissue mass, or other body region. It is also desirable in some situations to have one hand free to handle other equipment that is used when fluid is withdrawn from a patient.

Notwithstanding, a conventional syringe, such as is generally commercially available and used by medical providers and laboratory personnel, does not facilitate a one-handed technique, especially for withdrawing of fluids. This is because, as a user withdraws the plunger flange proximally along the longitudinal axis of the barrel, the distance necessarily increases between the barrel and the plunger flange. In other words, since the plunger flange is located proximal to the barrel, in the direction that the plunger must travel, it requires the user to move his or her fingers through an over-extended range of motion in order to maintain a vacuum and withdraw the plunger thereby pulling fluid or cells into the barrel.

This maneuver can be difficult to accomplish for those with normal hand/finger dexterity, and may be impossible for those with limited hand/finger dexterity and/or strength such as one with arthritis, or whose fingers are relatively short in length. An ergonomic syringe and adaptor, as described herein, helps solve this difficulty. Also, because it is more effective to use the syringe in a one-handed technique, for example to withdraw fluids, the maneuver can be accomplished more ergonomically and rapidly. This reduces the amount of time that a patient must be restrained or encouraged to remain still. In an emergency, the time savings has the potential to improve outcomes. Likewise, an ergonomic syringe, and an adaptor for use with existing conventional syringes, reduce potential trauma to a patient's blood vessel, tissue, or other body region during withdrawal of fluids, given that there is greater efficiency in stabilizing the barrel and associated needle placement in a one-handed technique. Moreover, those with limited hand/finger dexterity, strength, or digit length may be able to accomplish the task of one-handed fluid withdrawal, whereas otherwise they may not be capable of doing so with a conventional syringe. Also, it is expected that repetitive use injuries to users may be reduced due to ergonomic improvements over conventional syringes.

It will be understood by those having ordinary skill in the art, that conventional syringes are designed primarily for injecting fluids, for example vaccines or medications. Such designs, however, are not as suitable for withdrawing fluids because of the direction of movement of the plunger. With a one-handed syringe technique, because the fingers must spread and become over-extended, it becomes more likely that a user's hand or fingers will slip from contact with the

barrel and/or plunger flange during withdrawal. Additionally, as the distance increases, it becomes more difficult to apply sufficient force to the plunger flange, a task that some users (e.g., those having shorter fingers or limited dexterity and/or strength) may not be able to accomplish.

SUMMARY OF INVENTION

Based upon the foregoing, there are significant needs for ergonomic syringes, as well as adaptors that will interface with conventional syringes, to provide increased user control and stability when exerting mechanical force needed to move the plunger while withdrawing fluids, that reduce the overall range of motion that the finger must travel in order to exert such force, to reduce repetitive strain on the user during these maneuvers, to make the use of syringes more efficient and less difficult, to promote one-handed use, and to otherwise provide advantages for users having limited hand/finger strength. Further, there is a need to practically convert conventional syringes, which are designed to inject fluids, into syringes that are ergonomically designed to withdraw fluids and other matter using a one-handed syringe technique. The present embodiments, as described and claimed herein, meet these needs.

Accordingly, various embodiments and alternatives of an ergonomic syringe and adaptor, as described herein, improve and facilitate the withdrawal of fluids. By way of illustration only, the disclosed embodiments allow for one-handed operational functionality; incorporate features that promote ergonomically desirable and consistent finger placement on the syringe barrel; facilitate a user's ability to stabilize the syringe when in use for example, when introducing a hypodermic needle into the body of the patient; provide a contoured surface tailored to the functional position of the fingers and hand on the outer surface of the barrel; and/or reduce the range of motion that a finger in contact with the plunger flange must undergo in order to apply sufficient force to move the plunger within the barrel, thus creating a vacuum for withdrawing fluid from an external source. As used herein, the word "finger" includes all fingers or phalanges including the thumb, index, middle, ring, and pinky fingers (i.e., 1^{st} through 5^{th} digits of the hand). It is expected that such embodiments, as described herein, will tend to reduce repetitive use injuries that are sometimes experienced by phlebotomists and other users of syringes. It is also expected that such embodiments will enable those with limited dexterity and/or reduced hand/finger strength to accomplish the maneuvers associated with fluid withdrawal.

BRIEF DESCRIPTION OF THE DRAWINGS

The written description of multiple embodiments and alternatives, as set forth herein, will be better understood when read in connection with the appended drawings. It will be understood that the application is not limited to precise arrangements shown, nor are the illustrations intended as being drawn to scale.

FIG. **1** is an exploded view of an ergonomic syringe with a contoured barrel, according to multiple embodiments and alternatives.

FIG. **2** is a perspective view of an ergonomic syringe, according to multiple embodiments and alternatives.

FIG. **2**A is a perspective view of an ergonomic syringe that illustrates one way it can be operated by a user, according to multiple embodiments and alternatives.

FIG. **3** is a perspective view of a contoured barrel of an ergonomic syringe, according to multiple embodiments and alternatives.

FIG. **3**A is a perspective view of a contoured barrel of an ergonomic syringe, according to multiple embodiments and alternatives.

FIG. **4** is a perspective view of an ergonomic syringe, according to multiple embodiments and alternatives.

FIG. **4**A is a perspective view of an ergonomic syringe, according to multiple embodiments and alternatives.

FIG. **5** is a cross-sectional perspective view of an ergonomic syringe, taken along line I-I of FIG. **4**A, according to multiple embodiments and alternatives.

FIG. **6** is a perspective view of an ergonomic syringe, according to multiple embodiments and alternatives.

FIG. **6**A is a rear-facing perspective view of an ergonomic syringe, according to multiple embodiments and alternatives.

FIG. **7** is a perspective view of an adaptor fitted over a conventional syringe, according to multiple embodiments and alternatives.

FIG. **7**A is a cross-sectional perspective view of an adaptor fitted over a conventional syringe, in which the view is taken along line II-II of FIG. **7**, according to multiple embodiments and alternatives.

FIG. **8** is a side elevation view of an adaptor partially fitted over a conventional syringe, according to multiple embodiments and alternatives.

FIG. **8**A is a perspective view of an adaptor partially fitted over a conventional syringe, according to multiple embodiments and alternatives.

FIG. **9** is a plan view of an adaptor partially fitted over a conventional syringe, according to multiple embodiments and alternatives.

FIG. **10** is a cross-sectional perspective view of an ergonomic syringe of the kind shown in FIG. **4**A, taken along line I-I, according to multiple embodiments and alternatives.

MULTIPLE EMBODIMENTS AND ALTERNATIVES

The descriptions and teachings herein are suitable for the manufacture of new syringe products, yet also suitable for an adaptor that can be retrofitted or detachably secured to existing syringes, and then reused. The teachings and descriptions are particularly applicable to withdrawal of fluid from a patient's blood vessel, tissue, or other body region, as well as withdrawal of fluid from a vessel, e.g., a vial or a test tube.

FIG. **1** is an exploded view of an ergonomic syringe **10**, as described herein, according to multiple embodiments and alternatives. Syringe **10** comprises a barrel **20**, having a proximal end **33** and a distal end **35**. Generally, an aperture **29** is positioned at proximal end **33** of barrel **20**. Syringe **10** also comprises a plunger **26**, having a proximal end **50** and a distal end **52**. Axis **22** extends centrally through the length of barrel **20** and plunger **26**.

In some embodiments, syringe **10** also comprises slide member **28** as shown in FIG. **1**. Slide member **28** comprises a proximal end **70** and a distal end **72**, along with a ring **77** positioned between the two ends, at or substantially near distal end **72**. Ring **77**, including a distal facing surface **79** (which is labeled in FIG. **2**), is adapted for engagement by one or more fingers of a user during fluid withdraw. In some embodiments, ring **77** includes a flange extending radially outward that encircles the outer cylindrical circumference of barrel **20** when plunger **26** is positioned within barrel **20**. Optionally, ring **77** may have a concave surface to accommodate finger placement. In the embodiment depicted in FIG. **1**,

ring **77** is a unitary piece that encircles the entire 360° outer circumference of barrel **20**. However, in some embodiments (not shown), ring **77** may be segmented and/or only partially encircles barrel **20**.

In some embodiments, barrel **20** is generally cylindrical, having a rim **30** at its proximal end **33** which forms the periphery of aperture **29**. In some embodiments, plunger **26** further comprises a sealing member **56** positioned at or near at distal end **52**. Sealing member **56** is formed from materials suitable for creating and maintaining a fluid-tight seal between the distal portion of plunger **26** and the inner walls of barrel **20**, e.g., rubber, polymeric, elastomeric, or other suitable materials. In some embodiments, the inner diameter of the barrel formed by rim **30** is larger than the diameter of distal end **52** of plunger **26**. In this way, aperture **29** accommodates plunger **26** such that, in use, plunger **26** is at least partially inserted into the hollow space of barrel **20** for operational engagement and axial movement within the barrel. In some embodiments, plunger **26** comprises a unitary member in which a plurality of webs **27** are attached along a common edge, wherein the webs **27** extend perpendicular to axis **22**, while running parallel to axis **22**, to provide a sliding fit for plunger **26** within barrel **20**.

As shown in FIG. **1**, slide member **28** is attached to plunger at their respective proximal ends, **50** and **70**. Accordingly, a force exerted upon ring **77** produces movement of slide member **28** along axis **22**, thereby causing slide member **28**, plunger **26**, and sealing member **56**, respectively, to move a substantially equal distance along the same axis. In this way, force exerted upon ring **77** determines and influences the instantaneous positions of plunger **26** and sealing member **56**, respectively.

As shown in FIG. **2**, in most embodiments barrel **20** contains markings **41** indicating an amount of fluid contained within barrel **20**. Needle attachment **49** fits into opening **47** (as also shown in FIG. **1**) at the distal end **35** of barrel **20** through means that are known to those of ordinary skill in the art, e.g., a snap-fit engagement or threaded screw arrangement between needle attachment **49** and opening **47**. In many embodiments, opening **47** detachably receives needle **24** using components that are known in the art, e.g., a slip tip, catheter tip, Luer-Lok® and Luer-Slip®, and needle **24** further includes a needle opening **23** comprising a beveled edge **25**. FIG. **2** also illustrates ring **77** encircling the entire outer circumference of barrel **20** and the distal facing surface **79** of the ring.

FIG. **3** and FIG. **3**A, respectively, provide views of an ergonomic syringe **10**, according to multiple embodiments and alternatives, wherein the barrel **20** includes at least one finger placement aid. For example, the syringe shown in both figures has a contoured barrel **21** and a finger placement guide **36** for stable and consistent contact by a user with barrel **20**. In some embodiments, finger placement guide **36** is formed as a ridge to promote ergonomic engagement with a user's finger along contoured barrel **21** of syringe **10**. In some embodiments, a ridge that forms finger placement guide **36** is fabricated integral to contoured barrel **21** during manufacture. Optionally, as illustrated in FIG. **3**A, contoured barrel **21** includes a grip-enhancing material **37** substantially encircling at least a portion of an exterior surface of contoured barrel **21**. In some embodiments, grip-enhancing material **37** is formed separately from contoured barrel **21** and fitted over the exterior surface of the barrel. Alternatively, grip-enhancing material **37** is bonded to the surface of, or otherwise applied to, contoured barrel **21**. In some embodiments, the grip-enhancing material **37** comprises added material in the form of raised dots on the exterior surface of contoured barrel **21**, and is accompanied by a finger placement guide **36**.

FIG. **4** and FIG. **4**A, respectively, provide views of an ergonomic syringe **10**, according to multiple embodiments and alternatives. FIG. **4** illustrates syringe **10** having a barrel **20**, which includes a distally located first portion **39** of uniform outer circumference along its cylindrical length, and a second portion **40** of a smaller diameter along its cylindrical length, located proximally to the first portion **39**. As FIG. **4** illustrates, in some embodiments, a first tapered surface **44** of barrel **20** tapers inward, from a larger diameter at a distal end **35** of barrel **20** to a lesser diameter as it extends toward a proximal end **33** of the barrel. Alternatively, surface **44** of barrel **20** tapers outward, as shown in FIG. **4**A. In this way, surface **44** connects the first portion **39** with second portion **40**. Optionally, the diameter of second portion **40** is greater than the diameter of first portion **39**, as shown in FIG. **4**A. Also as shown in FIG. **4**A, in some embodiments, a second tapered surface **46** located at the distal-most end of first portion **39** gradually transitions to a diameter exceeding that of the rest of first portion. Accordingly, the difference in diameters within the first portion **39** itself also promotes ergonomic finger positioning and placement on contoured barrel **21**.

It will be appreciated that ring **77** has both a distal facing surface **79** and a proximal facing surface **78**, as identified by reference numerals used in FIGS. **2**, **4**, **5**, **6**, and **6**A. Both surfaces can be either flat, convex, or concave, as desired.

Now referring back to FIG. **4**A, during operation the combination of first portion **39** with tapered surface **44** allows for more natural placement and ergonomic positioning of fingers as selectably desired by a user. It also provides flexibility with regard to the location of fingers on barrel **20**, in order to position a different finger in contact with ring **77** in a more comfortable and functional way for a particular user. This improved functional hand and finger position allows a user to exercise greater stability and improved control of the syringe during use.

FIG. **5** is a cross-sectional view of an ergonomic syringe **10** taken longitudinally along line I-I of FIG. **4**A, with certain elements that were also depicted in FIG. **1**. In this view, needle attachment **49** is shown engaged with opening **47** at distal end of barrel **20**. Plunger **26** is substantially contained within the hollow space of barrel **20**. Distal facing surface **79** of ring **77** is positioned proximally of sealing member **56** with respect to axis **22**. In some embodiments, ring **77** is positioned substantially at the distal end of slide member **28**, and encircles the outer cylindrical circumference of barrel **20**. Plunger **26** comprises a substantially elongate body capable of movement within the hollow space of barrel **20**, along axis **22**, and also includes sealing member **56** at its distal end **52**. As plunger **26** is withdrawn axially, sealing member **56** remains in contact with the inner wall of barrel **20**.

As shown in FIG. **5**, in some embodiments, plunger **26** has a plunger flange **58** at its proximal end **50**. Plunger flange **58** has a distal facing surface **61** that faces distally, and a proximal facing surface **63** (as seen in FIG. **6**A) facing proximally. In some techniques, a user places two fingers in contact with barrel **20**, and places a third finger in contact with distal facing surface **79** of ring **77** in order to exert force to plunger flange **58**, thus moving it proximally along axis **22** in order to withdraw plunger **26** from barrel **20**. In this regard, it will be appreciated that a degree of variability exists in user technique. For example, third finger does not necessarily mean the middle finger, but rather a different finger than the two placed in contact with barrel **20**. If fluid is injected into a patient, a user places two fingers in contact with barrel **20**, and places a

third finger in contact with proximal facing surface **78** of ring **77**. Exerting force upon proximal facing surface **78** in a distal direction causes plunger **26** to move into, or further into, barrel **20**. This reduces the volume inside barrel **20** and causes fluid to be dispensed from the barrel through opening **47**. Optionally, when needle **24** is connected to barrel **20** via needle attachment **49**, it allows fluid that is being injected to exit the needle through opening **23**.

In embodiments having a contoured barrel **21** or a variable diameter barrel **20** (such as those shown in FIGS. **3**, **3**A, **4**, **4**A, **5**, and **6**), the sealing member **56** may include a resilient and flexible flange **88** (shown in FIG. **5**) extending about its periphery. Flange **88** maintains a fluid-tight seal between sealing member **56** and the inner walls of barrel **20** as the distal portion of plunger **26** moves along axis **22** from a portion of the barrel having a larger diameter into a portion of the barrel having a lesser diameter, and vice versa. Suitable materials for forming flange **88** include rubber, polymeric, elastomeric, and other materials having sufficient elastic recovery after deformation to maintain a fluid-tight seal under pressure and vacuum.

Alternatively, for embodiments in which syringe **10** has a contoured barrel **21**, or a barrel of varying diameter, a separate outer diameter barrel wall is provided where surface **44** of barrel **20** begins to taper from one barrel diameter to another barrel diameter, as shown in various figures, including FIG. **4**A and FIG. **10**. Referring to FIG. **10**, a constant diameter inner barrel wall **48** defines the internal space within barrel **20** through which plunger **26** and sealing member **56** travel axially. Outer barrel walls **80**, **86** are formed where surfaces **44**, **46** taper from contoured barrel **21**. Cavities **82**, **84** are formed between constant diameter barrel wall **48** and outer barrel walls **80**, **86**. Cavities **82**, **84** may be void, air-filled spaces or, alternatively, contain solid material such as, for example, the same material used to form barrel **20**.

Turning now to FIG. **6**, in some embodiments slide member **28** is formed integrally with the fabrication of plunger **26**. Alternatively, slide member **28** is fabricated separately from plunger **26**. Generally, slide member **28** has a proximal end **70** and a distal end **72**, with ring **77** being positioned at or near distal end **72**. In some embodiments, the ring **77** encircles the entire 360° outer cylindrical circumference of barrel **20**. Ring **77** further comprises a proximal facing surface **78** (as seen in FIG. **6**A) and a distal facing surface **79**. FIG. **6**A also provides a view of proximal facing surface **63** of plunger flange **58**.

It is often desirable to withdraw or partially withdraw plunger **26** from barrel **20** employing a one-handed technique. In order to do so, as shown in FIG. **2**A, a user may place two fingers (one being the thumb, in this figure) in contact with barrel **20**, at a position distal to ring **77**, and place a third finger or fingers in contact with distal facing surface **79** and exert force there, in order to move the plunger in the proximal direction. Compared to a conventional syringe, as further shown in FIG. **2**A, the third finger contacts the distal facing surface **79** of slide member **28** instead of having to extend to the plunger flange **58** (shown in FIG. **5**) of plunger **26**. The distance between the fingers in contact with barrel **20** and the distal facing surface **79** of slide member **28** is less, so a user does not have to reach as far with the third finger in order to contact the distal facing surface. This is illustrated by the fact that, with a conventional syringe, the plunger flange **58** is frequently positioned proximally beyond the reach of barrel rim **30**. By contrast, as shown in FIGS. **1**, **2**, **4**, **4**A, **5**, and others, ring **77** need not extend proximally to the same extent beyond barrel rim **30**. This positioning of ring **77** between proximal end **33** and distal end **35** of barrel **20** creates a relatively shorter distance between barrel rim **30** and ring **77**, and further promotes stability and control in the use of ergonomic syringe **10**. It will also be appreciated that, in some embodiments, the distance between ring **77** and the distal end **52** of plunger **26** will remain constant, particularly when ring **77** is integrally formed with plunger **26**.

In some embodiments, slide member **28** includes a first elongate arm **74** and a second elongate arm **75**, as shown in FIG. **6**. The elongate arms may be positioned 180° apart as defined by an outer rim of ring **77**. Alternatively, a single elongate piece (not shown) could be used in place of first and second elongate arms, **74**, **75**. Alternatively, syringe **10** could be constructed with slide member **28** having three or more elongate pieces positioned relative to each other at angles as selectably desired by a user, for example 120° as defined by the above-mentioned outer rim, or any number of elongate arms in like fashion. In all such embodiments, at one end the elongate arms **74**, **75** and/or elongate piece are attached to the proximal facing surface **78** of ring **77**, while at the other end they are attached to a distal facing surface **61** of the plunger flange **58**, which consistently maintains the correspondence of movement between slide member **28** and plunger **26**, such that as ring **77** moves, so does plunger **26**. Attachment is accomplished through any of a number of methods known to those having ordinary skill in the art, and is typically performed at the time of fabricating plunger **26**, though this is not required.

In some embodiments, elongate arms **74**, **75** are straight, and extend parallel to axis **22**, as illustrated in FIG. **6**. Alternatively, elongate arms **74**, **75** extend at an angle to axis **22**. In some embodiments, ring **77** is a circular member. Alternatively, ring **77** comprises a flange extending outward relative to axis **22**, and otherwise having a cross-section of straight-line segments forming a polygonal shape (not shown), e.g., rectangular, octagonal or hexagonal. The latter configuration limits rolling motion of syringe **10**, thereby preventing it from rolling off of a surface when not in use.

Whereas the above descriptions and teachings relate to an ergonomic syringe **10**, the following relate to an ergonomic adaptor **100** (sometimes referred to herein simply as, adaptor) for use with an existing conventional syringe, and which can be reusable. The conventional syringe may include a barrel **20**, plunger **26**, webs **27**, sealing member **56**, and plunger flange **58** as described herein. FIG. **7** provides a view of ergonomic adaptor **100** fitted over a conventional syringe, which includes a barrel **20** with barrel flange **38**, and FIG. **7**A is a cross-sectional view of the same. Adaptor **100** has a proximal end **103** and a distal end **105**. It also includes a first elongate arm **110** and a second elongate arm **111**. In some embodiments, adaptor **100** is configured to circumvent barrel flange **38** as it establishes a mechanical connection between a portion of a ring **112** (in the form of a radially extending flange) and plunger flange **58**. Techniques available for finger placement on barrel **20** and ring **112** are substantially similar to those described above with respect to ergonomic syringe **10**, and ring **77**, as is the option between flat and curved surfaces for ring **112**, and the geometric shapes for ring **112**.

As also shown in FIG. **7** and FIG. **7**A, in some embodiments, first elongate arm **110** is straight as it extends from ring **112** in a proximal direction. Adaptor **100** further comprises a first extension elbow **118**, preferably positioned at an approximately 90° angle to first elongate arm **110**, which connects elongate arms **110**, **111**. Moving proximally along adaptor **100**, a second extension elbow **120** is attached to second elongate arm **111**, and preferably these two members are likewise positioned at an approximately 90° angle. In some embodiments, as illustrated in FIG. **8** second elongate arm **111** and second extension elbow **120** are joined to second

ring **107** through use of a hinge **117** forming a hinged joint, which allows for adjustable movement radially of second extension elbow **120**, thus enabling adaptor **100** to be fitted over and/or removed from plunger flange **58** of an existing syringe. Hinge **117** may be formed from the same material used in forming the other pieces of adaptor **107**. In some embodiments, hinge **117** is formed as a living hinge from polyethylene, polypropylene, or other suitable thermoplastic having sufficient fatigue resistance. When fitting the adaptor over the syringe, the radial movement of extension elbow **120** is inward toward the barrel, while radial movement away from the barrel is for removing it. With adaptor **100** securely fitted over plunger flange **58**, the exertion of force on ring **112** produces axial movement of adaptor **100**, thereby causing plunger flange **58**, plunger **26** and sealing member **56** to move a substantially equal distance along the same axis.

Adaptor **100** thus is suitable to achieve and maintain a functional and relatively snug fit with many forms of a conventional syringe. In some embodiments, a first elongate arm **110'** and second elongate arm **111'** are essentially configured in the same way as with arms **110**, **111**, including a first extension elbow **118'** and second extension elbow **120'**. In some embodiments, first elongate arms **110**, **110'** are positioned 180° apart as defined by the outer periphery of ring **112**. Proximal ends of extension elbows **120**, **120'** are joined together by the second ring **107**, which fits over proximal facing surface **63** of plunger flange **58**, such that second elongate arms **111**, **111'** are also positioned 180° apart. As stated in connection with the syringe, the present embodiments are not limited to a certain number of extension arms.

FIG. **8** provides a side elevation view of adaptor **100** partially fitted over a conventional syringe. In some embodiments, ring **112** of adaptor **100** consists of two semi-circular members, **121**, **122**. Given that there are two members, some embodiments include more than one first elongate arm **110** (another being denoted as **110'**), more than one second elongate arm **111** (another being denoted as **111'**), more than one first extension elbow (**118'**), more than one second extension elbow (**120'**), and more than one hinge (**117'**). First semi-circular member **121** is attached to first elongate arm **110**, and second semi-circular member **122** is attached to first elongate arm **110'**. However, in some embodiments (not shown), ring **112** is a unitary member with an opening sized to fit snugly around the distal end **35** of barrel **20** (in the same way as described with FIG. **1**). Whether one-piece or multiple pieces, preferably ring **112** encircles barrel **20**.

Turning back to FIG. **7** and FIG. **7**A, the position of adaptor **100** is then adjusted axially along the length of barrel **20**, until second extension elbows **120**, **120'** are positioned for contact and operational engagement with plunger flange **58**. Second elongate arms **111**, **111'** are then moved radially toward each other and towards barrel **20**, and in this way placed into mechanical contact with or otherwise attached to plunger flange **58**. In this placement, the correspondence of movement is consistently maintained between adaptor **100** and plunger **26**, such that as ring **112** moves, so does the plunger **26**.

Whereas FIG. **7** shows barrel **20** completely encircled by ring **112**, in FIG. **8** semi-circular members **121**, **122** are disengaged from each other. Once engaged, or otherwise connected, the two members form a ring that encircles barrel **20**. As FIG. **8** shows, first member **121** contains spaces **124**, **126** that are capable of mating with first latch **123** (hidden behind barrel **20** in the drawing figure) and second latch **125**, respectively, of second member **122**. Spaces **124**, **126** and latches **123**, **125**, respectively, are of suitable size and shape to allow them to snap fit into place securely in order to complete the encirclement of barrel **20** by ring **112**. Further, in some embodiments, a slot, **115**, or plurality of slots, are formed along a surface of second extension elbows **120**, **120'**, with each slot **115**, being substantially perpendicular to second elongate arms **111**, **111'**, for accommodating the webs **27** of plunger **26**.

Once adaptor **100** is fitted onto an existing syringe, the use is substantially the same as described above for ergonomic syringe **10**. Preferably, adaptor **100** is designed for use with conventional syringes of varying designs and/or capacities, although it may also be designed specifically for and matably used with an individually designed syringe. In some embodiments, adaptor **100** is reusable, in that it can be removed from one syringe and attached for use with a different syringe, which is generally of similar size and capacity. Although not shown, various alternatives exist for joining semi-circular members **121**, **122**, such that they can be easily detached for removal of adaptor **100**. For example, members **121**, **122** may be joined by latch with latch post and latch tab, clasp, dovetail joint, compression snap, interference snap, or cantilevered clip with angled hook face (not shown), all of which are known in the art. The joining structures can be incorporated into members **121**, **122** at fabrication.

One way of removing adaptor **100** from a syringe is by grasping each semi-circular member **121**, **122**, and exerting an opposing force on each sufficient to pull them apart. Alternatively, adaptor **100** can be designed so that a surface of semi-circular member **121** overlays a surface of second semi-circular member **122**, and joined with a screw that fits into a threaded hole formed in both surfaces, and further secured by the use of, e.g., a nut.

FIG. **8**A provides a different view of adaptor **100** partially fitted over a conventional syringe. As previously mentioned, in some embodiments, second extension elbows **120**, **120'** are attached to second ring **107** at hinge **117**, thus enabling radial movement. Adaptor **100** is fitted over the syringe through radial movement inward toward the barrel, while radial movement away from the barrel is for removing it. Attachment of the extension elbows **120**, **120'** to second ring **107** is accomplished through any of a number of methods known to those having ordinary skill in the art, and is typically performed at the time of fabricating adaptor **100**, though this is not required.

FIG. **9** provides a plan view of adaptor **100** partially fitted over a conventional syringe in an alternative embodiment. In this configuration, radial movement relative to axis **22** of each of second extension elbows **120**, **120'** is for fitting adaptor **100** over an existing syringe, or for removal depending on the direction of movement. Extension elbows **120**, **120'** are attached to second ring **107** at hinges **117**, **117'**, and the hinges are configured to allow radial movement as described in connection with other embodiments for adaptor **100**. In the embodiment of FIG. **9**, however, the location of hinge **117** is inferior to plunger flange **58**, whereas in FIG. **8**A the location is superior. Accordingly, in FIG. **9**, each of extension elbow **120**, **120'** further comprises a first notch **128** and second notch **130**, respectively, which are appropriately sized and adapted to releasably secure extension elbows **120**, **120'** to the sides of plunger flange **58**.

With reference to prior figures, including FIG. **2**A, FIG. **5**, and FIG. **7**, respectively, further description is now provided about the operation of an ergonomic syringe **10**. The description of the apparatus in operation would be substantially the same for a conventional syringe with adaptor **100**. To withdraw fluid, a user typically grips ergonomic syringe **10** with two or more fingers near distal end **35** (or, in certain embodiments, at contoured barrel **21**) of barrel **20** and then inserts

needle **24** into a source from which fluid is to be withdrawn, which can be a patient. Then the user places a third finger in contact with distal facing surface **79** of ring **77** (according to FIG. **2**A, or ring **112** in FIG. **7**), and exerts sufficient proximal force thereto in order to partially withdraw plunger **26** from barrel **20**, thus withdrawing fluid from the patient or other source through the movement of plunger **26** in a proximal direction relative to barrel **20**, along axis **22**.

Once a desired quantity of fluid is withdrawn, the extension of the finger in contact with ring **77** (or, **112** in the adaptor embodiments), away from the fingers in contact with barrel **20**, ceases. At that point, if the user desires, the position of the ring is maintained and she then removes needle **24** from the patient. Throughout this sequence, a user has one hand free and is available to provide auxiliary support to the operation as needed (e.g. support of patient's limb). Still, a user does not have to reposition the fingers of the hand in contact with barrel **20** in order to contact distal facing surface **79** and withdraw plunger **26**. This facilitates a stable and consistent one-handed technique for withdrawing fluid from a patient.

As referenced in FIG. **2**, needle **24** has opening **23** at its proximal end, in the form of beveled edge **25**. When inserting the needle into the patient, i.e., passing it through the skin and into the blood vessel, it is desirable to have beveled edge **25** facing upward. The fact that ring **77** (**112**) completely encircles the outer cylindrical area of barrel **20** facilitates a user in keeping the beveled edge in the upward position. But with a conventional syringe, not having ring **77** (**112**) it is possible for plunger flange **58** to be oriented where a user cannot easily make suitable contact with its surface **112** (e.g., where a plunger web **27** reduces available contact area for finger positioning on plunger flange **58**). In order to adjust to that situation, with a conventional syringe a user would have to rotate barrel **20** in order to position plunger flange **58** in a location more accessible to her finger(s). However in the present embodiments, in rotating barrel **20**, beveled edge **25** of opening **23** may no longer be facing upward in the desired orientation for insertion into the patient. In such situation, beveled edge **25** and, therefore, needle opening **23**, are not suitably oriented for entering the skin. However, with ring **77** (**112**) completely encircling barrel **20**, this type of problem is not encountered because a user is free to position the third finger at any location radially along ring **77** (**112**) as is more comfortable, feasible, or accessible, in order to apply force needed to withdraw plunger **26**.

It will also be understood that in may embodiments, for both the ergonomic syringe and the adaptor as described and claimed herein, ring **77** (**112**) provides additional surface area for contact by the user compared to the area of distal facing surface **61** of plunger flange **58** (see FIG. **5**) as would be found on a conventional syringe. The additional surface area on ring **77** (**112**) promotes improved finger-to-ring contact. This reduces the chances of the finger slipping compared to when a user must contact plunger flange **58** in order to move plunger **26** along axis **22**. Moreover, this additional contact surface area on ring **77** (**112**) reduces the pressure on the finger as it applies force to move the plunger proximally. In some embodiments, a traction-enhancing material is adhered upon either or both surfaces of ring **112**, which further promotes finger-to-ring contact in order to avoid slippage. Ring **112** can be positioned to reduce overall range of motion that a finger in contact with a surface of ring **112** must travel relative to the other fingers in order to apply sufficient force to withdraw plunger **26** and, in so doing, to withdraw fluid from a patient. Additionally, this more ergonomic positioning of the hand/fingers allows greater force to be exerted for moving ring **112**, which can provide advantages for users having limited hand/finger strength.

In some instances, plunger **26** may only have to move 1-2 centimeters in order to withdraw the desired amount of fluid. However, in other instances, plunger **26** must travel significantly longer distances. Longer distances equates to the need for greater extension of the finger in order to move the plunger. In this respect, whatever distance plunger **26** must travel, with the present embodiments, a user's fingers extend through a smaller range of motion while pushing the ring to move the plunger than when they do when using a conventional syringe. This increases the amount of stability, control and comfort for the user, as well as for the patient. Moreover, this improved operation reduces the stress on the user's hand/fingers, thus reducing the likelihood of injury associated with repetitive usage.

The foregoing descriptions of multiple embodiments and alternatives are meant to illustrate, rather than to limit the scope of what has been disclosed herein. While multiple and varying embodiments of the presently disclosed technology have been illustrated and described herein, it will be apparent to those having ordinary skill in the art that modifications can be made. To the extent not otherwise disclosed herein, materials for the syringe and adaptor may be the same as those used for conventional design. Moreover, while individual features of various embodiments may be shown in some drawings but not in others, skilled in the art will recognize that individual features of one embodiment are capable of being combined with any or all features of another embodiment.

Thus, it is to be understood that these embodiments are not limited in their application to the details of the teachings and descriptions set forth herein, or as illustrated in the drawings. Rather, it will be understood that an ergonomic syringe, and adaptor, are capable of other embodiments and of being practiced or of being carried out in various ways. It will also be understood that certain terminology used herein is for the purpose of description and should not be regarded as limiting. The use herein of "including," "comprising," "e.g.," "containing," or "having" and variations of those words is meant to encompass the items listed thereafter, and equivalents of those, as well as additional items.

I claim:

1. An adaptor for a syringe having an at least partially hollow barrel and a plunger, the barrel having a proximal end and a distal end, with an aperture positioned at the proximal end for accepting the plunger, and the plunger being adapted for insertion into the aperture for movement axially within the barrel, comprising:

at least one ring; and

a plurality of elongate arms positioned axially along the exterior of the barrel, each having a first end attached to the ring and a second end attached to the plunger;

wherein exerting force axially upon the at least one ring produces axial movement of the adaptor along the barrel, thereby causing the plunger to move a substantially equal distance as the ring along the same axis;

and wherein at least one of the elongate arms further comprises a slot spatially adapted to accommodate a web of the plunger.

2. An adaptor for a syringe having an at least partially hollow barrel and a plunger, the barrel having a proximal end and a distal end with an aperture positioned at the proximal end for accepting the plunger and a barrel flange positioned near the proximal end of the barrel; and the plunger being adapted for insertion into the aperture for movement axially within the barrel, comprising:

a first ring and a second ring, one being positioned closer to the distal end of the barrel than the other, wherein at least one of the rings comprises a plurality of members arranged to form a detachable connection; and

a plurality of elongate arms extending axially along the exterior of the barrel;

at least one extension elbow positioned between the first ring and the second ring for connecting two elongate arms;

wherein exerting force axially upon the ring positioned closer to the distal end of the barrel produces axial movement of the adaptor along the barrel, thereby causing the plunger to move a substantially equal distance along the same axis.

3. The adaptor of claim **2**, wherein the detachable connection is formed by means chosen from the group latch, clasp, dovetail joint, compression snap, and interference snap.

4. The adaptor of claim **2**, wherein a hinge joins the at least one elongate arm and the at least one extension elbow to the second ring.

5. The adaptor of claim **2**, wherein the at least one extension elbow further comprises a slot spatially adapted to accommodate a web of the plunger.

6. The adaptor of claim **1**, further comprising a second ring attached to the plunger, wherein the elongate arms connect the first ring to the second ring.

7. The adaptor of claim **1**, wherein the at least one ring comprises a plurality of members, each arranged for detachable connection with the other.

8. The adaptor of claim **7**, wherein the detachable connection is formed by means chosen from the group latch, clasp, dovetail joint, compression snap, and interference snap.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,067,023 B2
APPLICATION NO. : 13/676810
DATED : June 30, 2015
INVENTOR(S) : Gina E. Bertocci

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page of the Letters Patent, Applicant Item (71), University of Louisville Research Foundation, Inc., delete "Nashville, TN" and add "Louisville, KY".

Signed and Sealed this
Third Day of November, 2015

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office